Modelling Challenge: Missionaries and Cannibals State Space Problem Solver

1. PROBLEM STATEMENT

Three missionaries and three cannibals are on the left bank of a river and trying to get across a river using one boat. At most two people can fit in the boat at one time. If at any time the number of cannibals outnumbers the number of missionaries on either side of the river, the cannibals will consume the missionaries. The goal is to safely get everyone to the right bank of the river.

2. THE OBJECTS OF THE STATE SPACE WORLD

M – Missionaries

C – Cannibals

B - Boat

3. REPRESENTATION OF A STATE OF THE WORLD

A state in this exercise will be represented as:

(MMMCCCB , -)

This is a representation of the initial state. The objects on the left side represent the way the left bank is populated and the – on the right side represents that the right bank is empty. A representation after moving a Missionary and Cannibal to the right bank would be:

(MMCC , MCB)

4. THE STATE SPACE DESCRIPTION

Set of initial States I: (MMMCCCB , -)

Set of goal states G: (- , MMMCCCB)

Set of state space operators O = (MR, MMR, CR, CCR, MCR, ML, MML, CL, CCL, MCL)

MR = One missionary moves to the right bank

MMR = Two missionaries move to the right bank

CR = One cannibal moves to the right bank

CCR = Two cannibals move to the right bank

MCR = One missionary and one cannibal move to the right bank
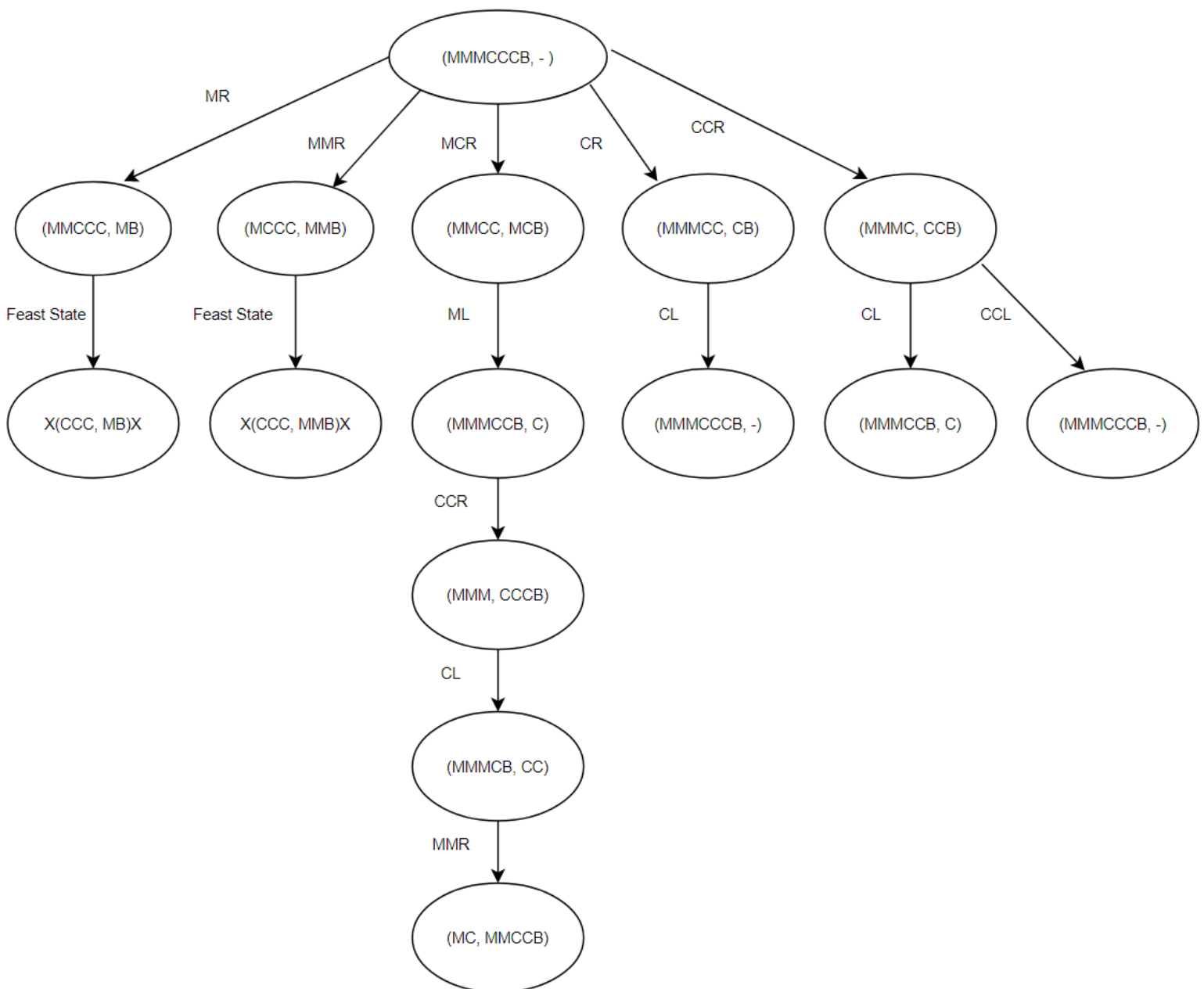
ML = One missionary moves to the left bank

MML = Two missionaries move to the left bank

CL = One Cannibal moves to the left bank

CCL = Two cannibals move to the left bank

MCL = One missionary and one cannibal move to the left bank

5. STATE SPACE GRAPH (INCLUDING AT LEAST ONE SOLUTION)

```
                              (MMMCCCB, - )
              MR                                          CCR
                    MMR         MCR        CR
  (MMCCC, MB)   (MCCC, MMB)  (MMCC, MCB)  (MMMCC, CB)  (MMMC, CCB)

  Feast State   Feast State     ML          CL          CL      CCL

  X(CCC, MB)X   X(CCC, MMB)X  (MMMCCB, C)  (MMMCCCB, -)  (MMMCCB, C)  (MMMCCCB, -)

                              CCR
                           (MMM, CCCB)

                              CL
                           (MMMCB, CC)

                              MMR
                           (MC, MMCCB)
```

```
        ┌─────────────┐
        │ (MC, MMCCB) │
        └─────────────┘
              │  MCL
              ▼
       ┌───────────────┐
       │ (MMCCB, MC)   │
       └───────────────┘
              │  MMR
              ▼
       ┌───────────────┐
       │ (CC, MMMCB)   │
       └───────────────┘
              │  CL
              ▼
       ┌───────────────┐
       │ (CCCB, MMM)   │
       └───────────────┘
              │  CCR
              ▼
       ┌────────────────┐
       │ (C, MMMCCB)    │
       └────────────────┘
              │  CL
              ▼
       ┌───────────────┐
       │ (CCB, MMMC)   │
       └───────────────┘
              │  CCR
              ▼
       ┌────────────────┐
       │ ( -, MMMCCCB)  │
       └────────────────┘
```
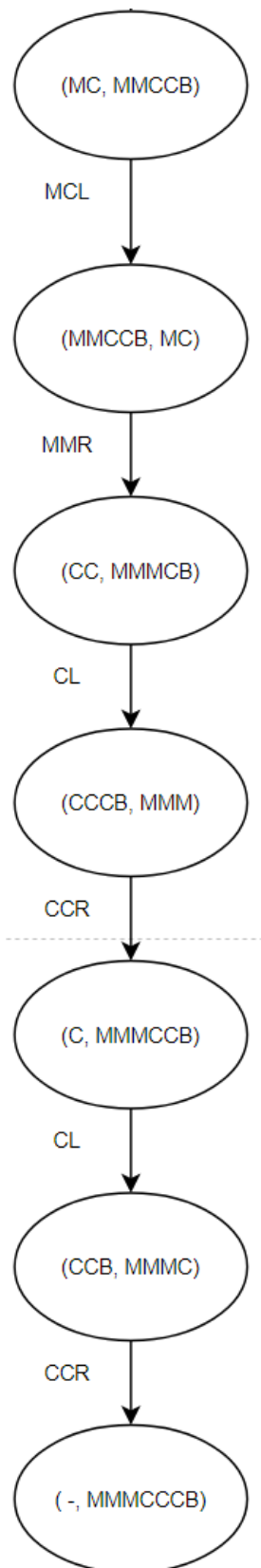
6. STATE SPACE SOLUTION (AT LEAST ONE)

MCR -> ML -> CCR -> CL -> MMR -> MCL -> MMR -> CL -> CCR -> CL -> CCR